



Virtualization Workshop

Capacity Building and Virtual Technologies



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Virtualization Technologies

They are everywhere...

By abstracting functionality away from hardware we gain

- Improved capacity usage
- Lower power consumption
- Reduced system administration overhead
- Better reliability (uptime, data loss)
- Possibilities that we are still thinking of...

Two kinds of virtualization

Consolidation

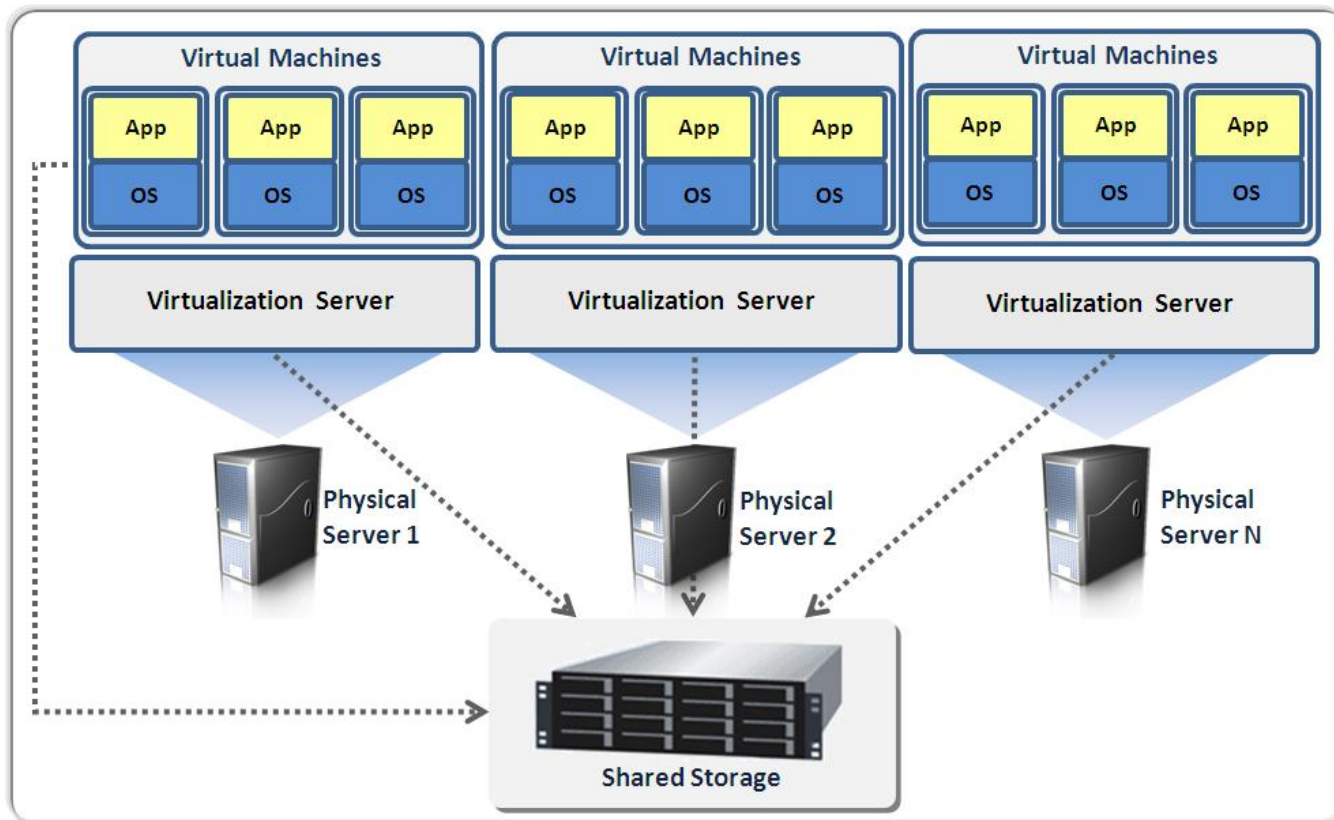
Run many services and servers onto fewer physical machines: increases ***efficiency***

Aggregation

Distribute applications and resources across as many virtual servers as required, turning resources on or off as need: increases ***scalability***

Some virtualization benefits

Reduced power use and better use of resources through **consolidation**



More benefits

Standardized platform

- Heterogeneous hardware platform hidden away behind virtualization
- Makes it easy to move hosts between platforms
- Not tied to a particular vendor – migrations are easy

Open Source offerings on par with commercial solutions and preferred by the “big boys”



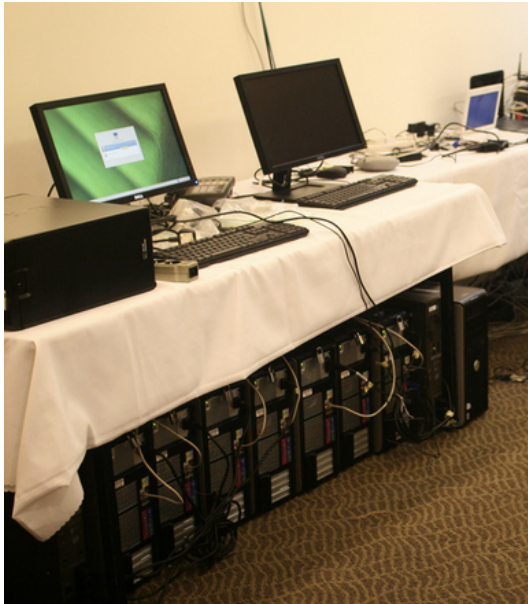
AfNOG technical capacity trainings

Instructors, staff, students and the institution have clearly benefitted...

AfNOG Trainings 2000-2010...



...lots of setup



Logistical benefits are obvious

In the context of regional and local training:

- “Virtualizing” = less hardware (better use)
- Reduced shipping costs
- Reduced Logistics
 - Customs / import
 - Network equipment is often considered to be “telecommunications” – taxation issues, licensing
 - Small footprint – fits in a backpack or carry-on
 - Peripheral infrastructure (access points, desktop switches) are very small

AfNOG 2013 we've virtualized

Approximate numbers

- 140 PCs
- 40 routers
- 30 switches
- 3-5 full-sized tower PCs
- Keyboards, monitors, mice and network cabling down to...

Virtual AfNOG 2013

- This represents ***significant overkill*** (2x or more).
- Much more could be virtualized...



Motivations and benefits

Other benefits than logistics are well aligned with the needs of regional / decentralized training:

- Adaptability
- Educational

We will cover these in the next slides

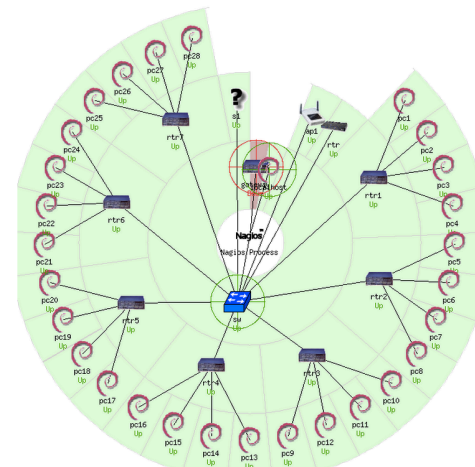
Benefits: Adaptability

- Single architecture multiple workshops
- Architecture and platform uncoupled
 - A **Mac** running **Linux** running **FreeBSD**
 - A **PC** running **Linux** running **Windows**
- ***Fast*** reconfiguration!
 - Can be done in minutes with templates.

Let's see this now!

(Next slide for images)

NMM Live in the room



A smorgasbord of choices!

Full virtualization

- KVM (Linux and Solaris only)
- Parallels (Mac OS X only)
- QEmu
- VirtualBox (Windows, Linux, Mac, FreeBSD)
- Virtual PC (Windows only)
- VMware (Workstation/Fusion, ESX)
- Windows Hyper-V
- Xen

Lightweight/pseudo

- FreeBSD / Linux Jails/LXC/OpenVZ



Network Simulation

- Marionnet
- Navy CORE

Network Emulation

- Dynamips /
Dynagen /
GNS3
- Olive (Juniper)
- Cisco IOU (private)

Some virtualization frameworks

Manage/deploy virtualization in a controlled fashion

- VMWare vCenter (commercial – enterprise)
- Libvirt (for managing KVM, Xen, VirtualBox)
- Ganeti, Synnefo – clustering, small to med. size
- OpenStack, Eucalyptus – large scale (cloud provider)

What do we use?

Hardware

- MacMini Server, 16GB RAM, 2x256 SSD, i7 quad core
- (Optional) fanless, Gigabit, managed 8-port switch
- Ubiquiti UniFi Pro AP or Netgear AP

Software

- Ubuntu Linux 12.04 LTS 64-bit
- KVM (Kernel based Virtual Machine)
- dynamips/dynagen
- Ansible

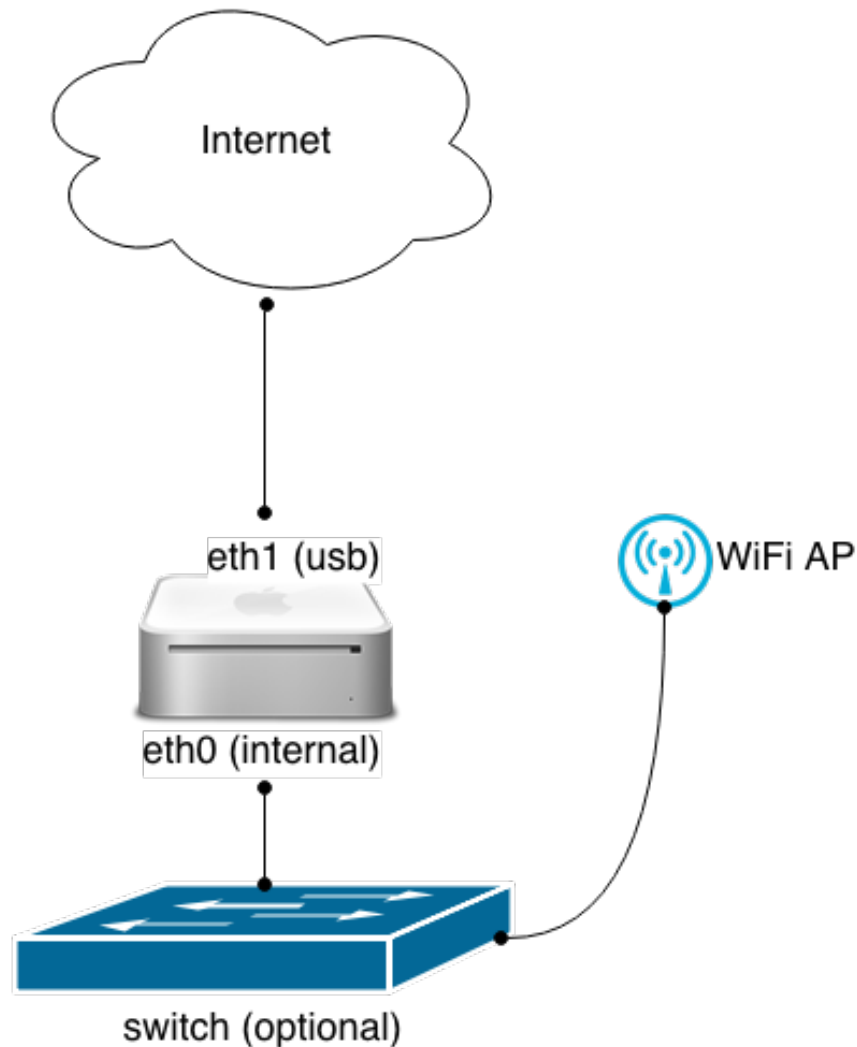


What do we use?

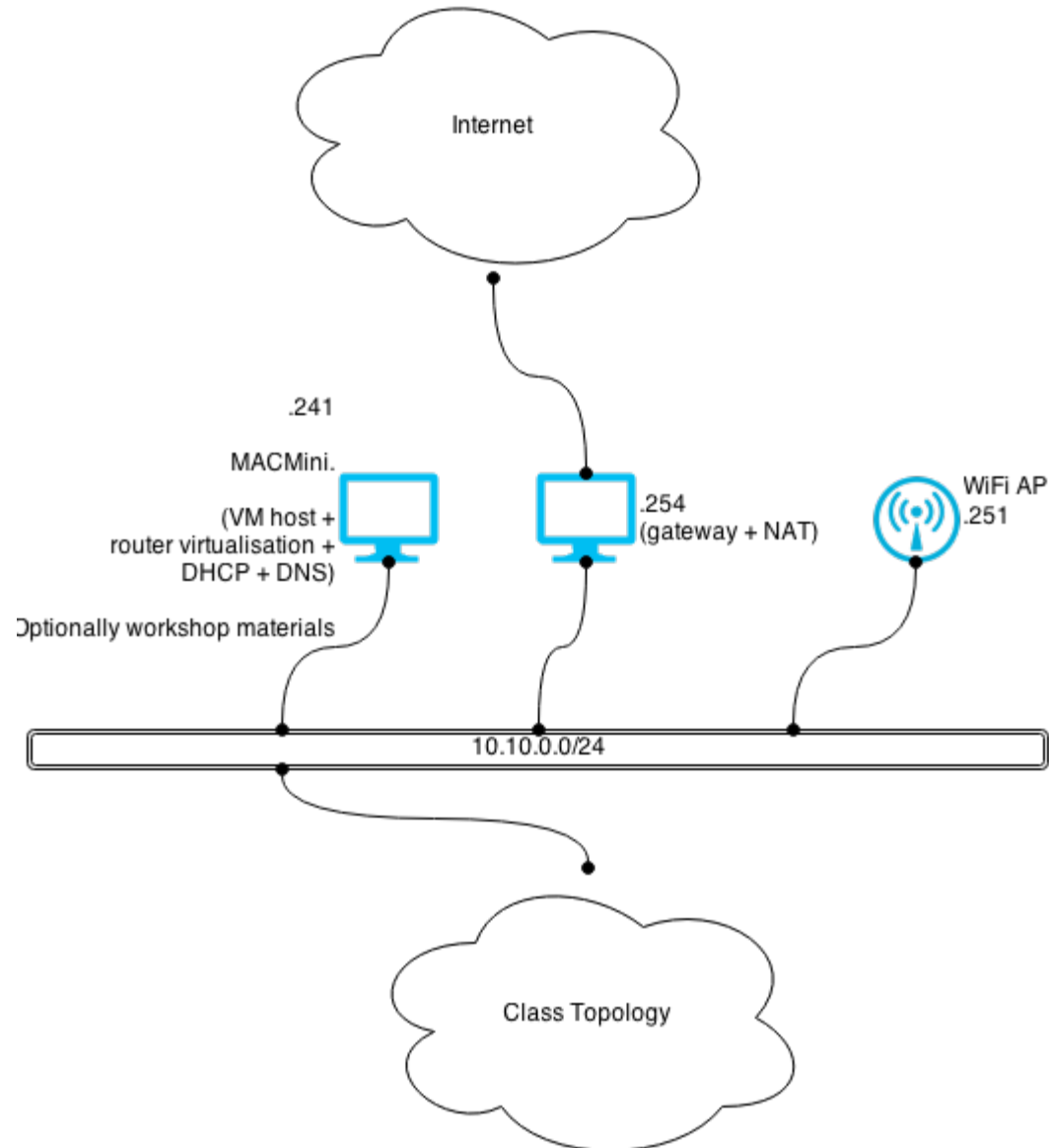
Hardware

- We use the MacMini for convenience (power / size ration = very good)
- Can use any reasonably modern machine with virtualization extensions (VT-x/VT-d) in the CPU
- Tower PC with Core i7, 7200 RPM disks
- Rackmount server, Xeon/Opteron, faster disks
- SSD disks are very nice, but not critical
- RAM is a big factor

Classroom Layout (physical)



Classroom layout (logical pieces)



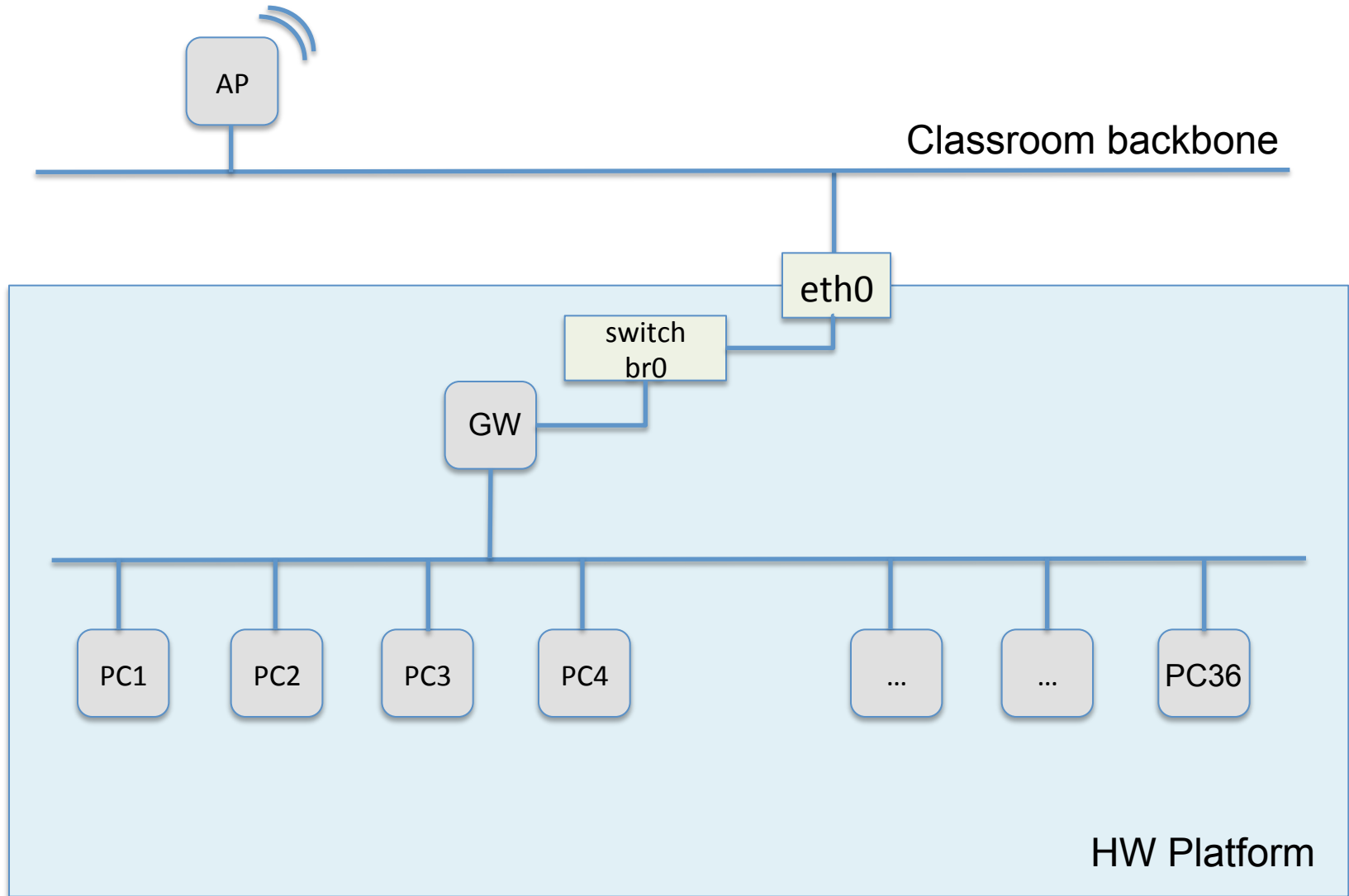
Concerning materials

- The class materials need to be hosted somewhere so students can download them.
- NSRC has been using wikis – and we use trac for it.
- The optimal place should be linked to from wherever the website describing the training is.
- In either case, a local copy of materials is sometimes useful to save bandwidth.

Some classroom virtual environments

- Flat, simple network (UNIX / Linux intro)
- Campus Network Design (L2 and L3)
- Network Monitoring and Management
- Hybrid of virtual networks
- DNS/DNSSEC workshop

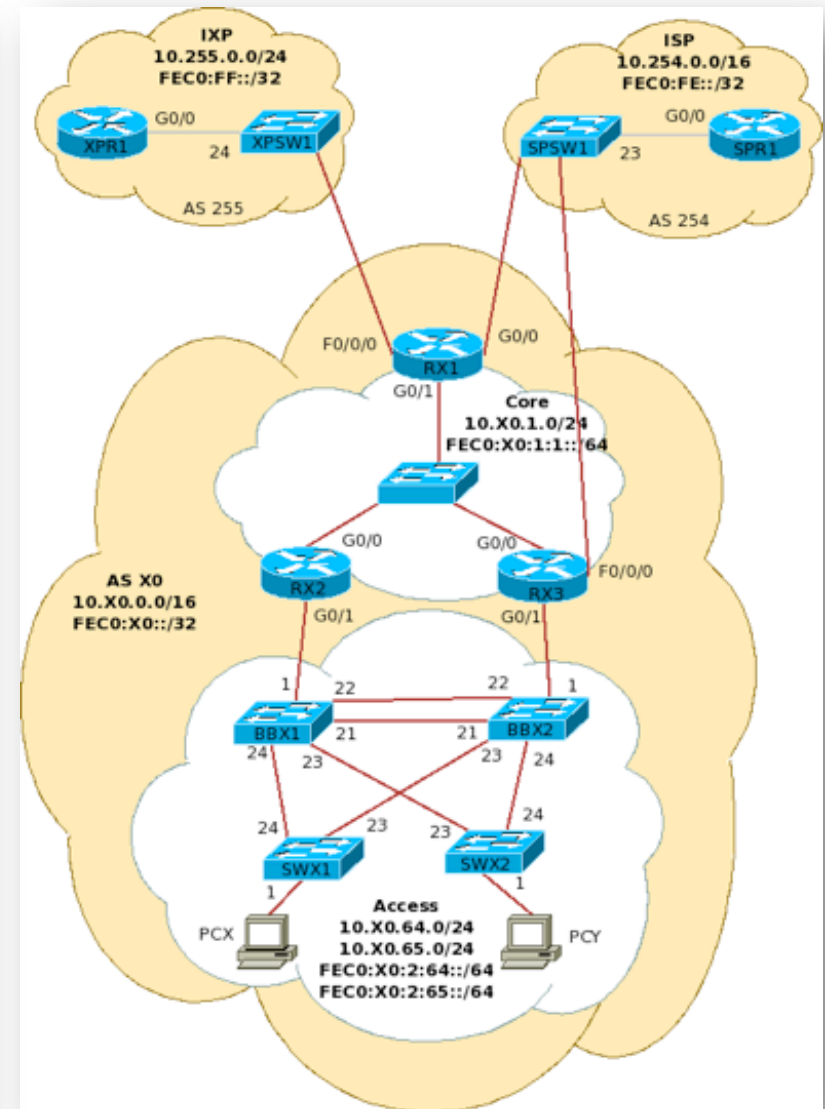
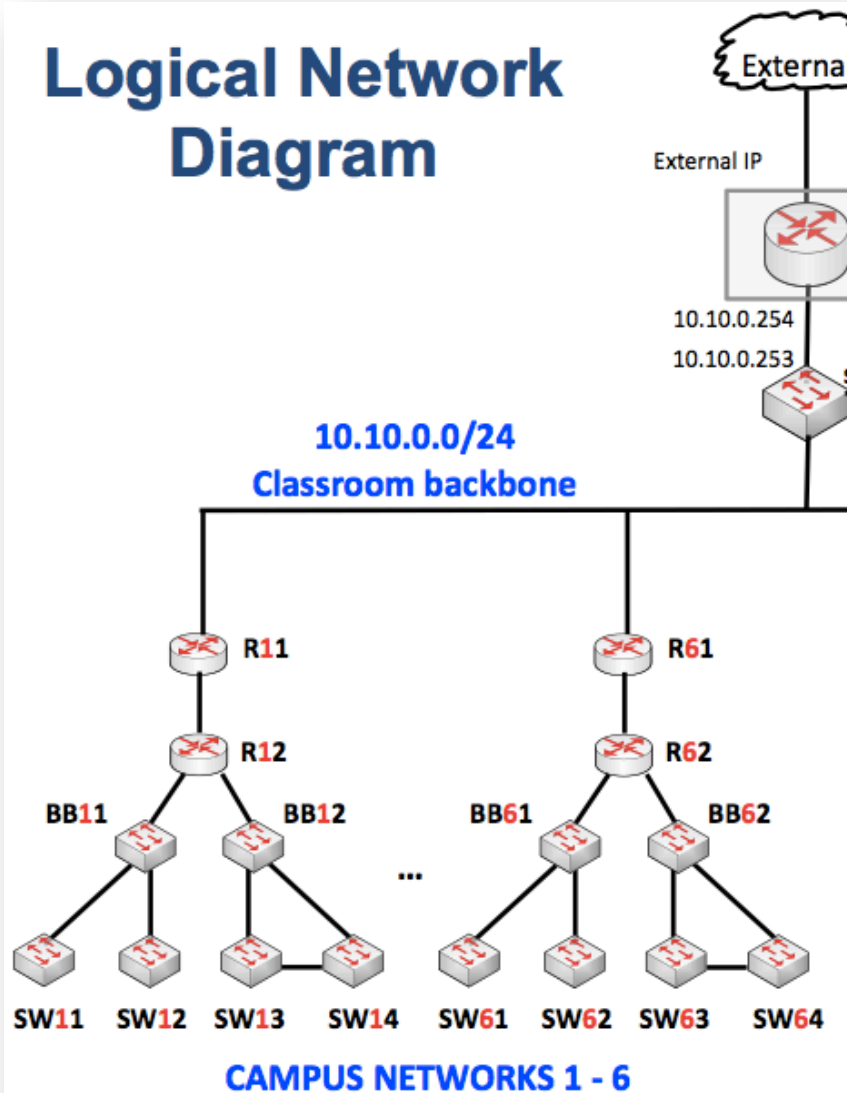
UNIX / Linux Introduction



36+ virtual machines on one server

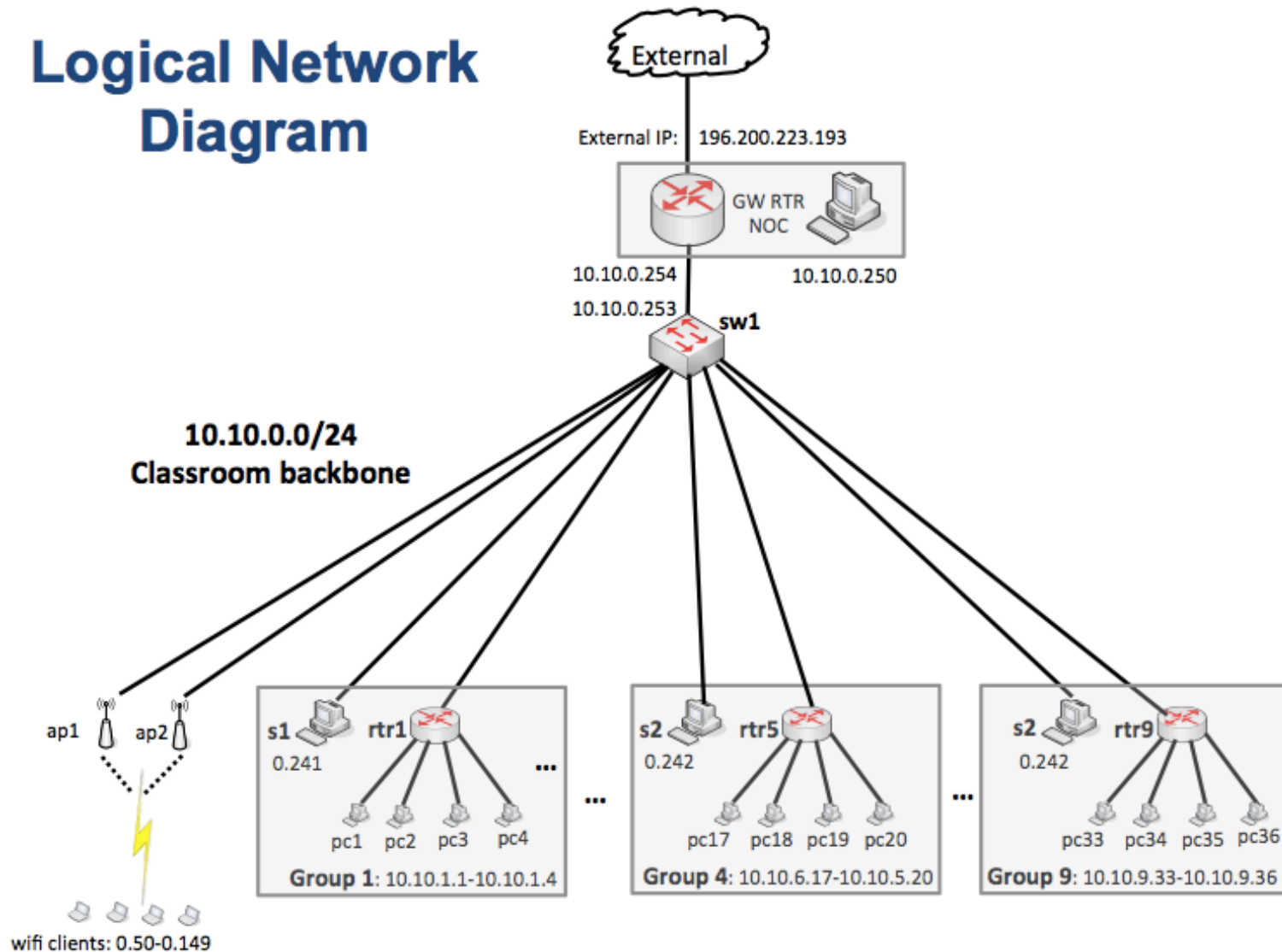
Campus Network Design (CND)

Logical Network Diagram



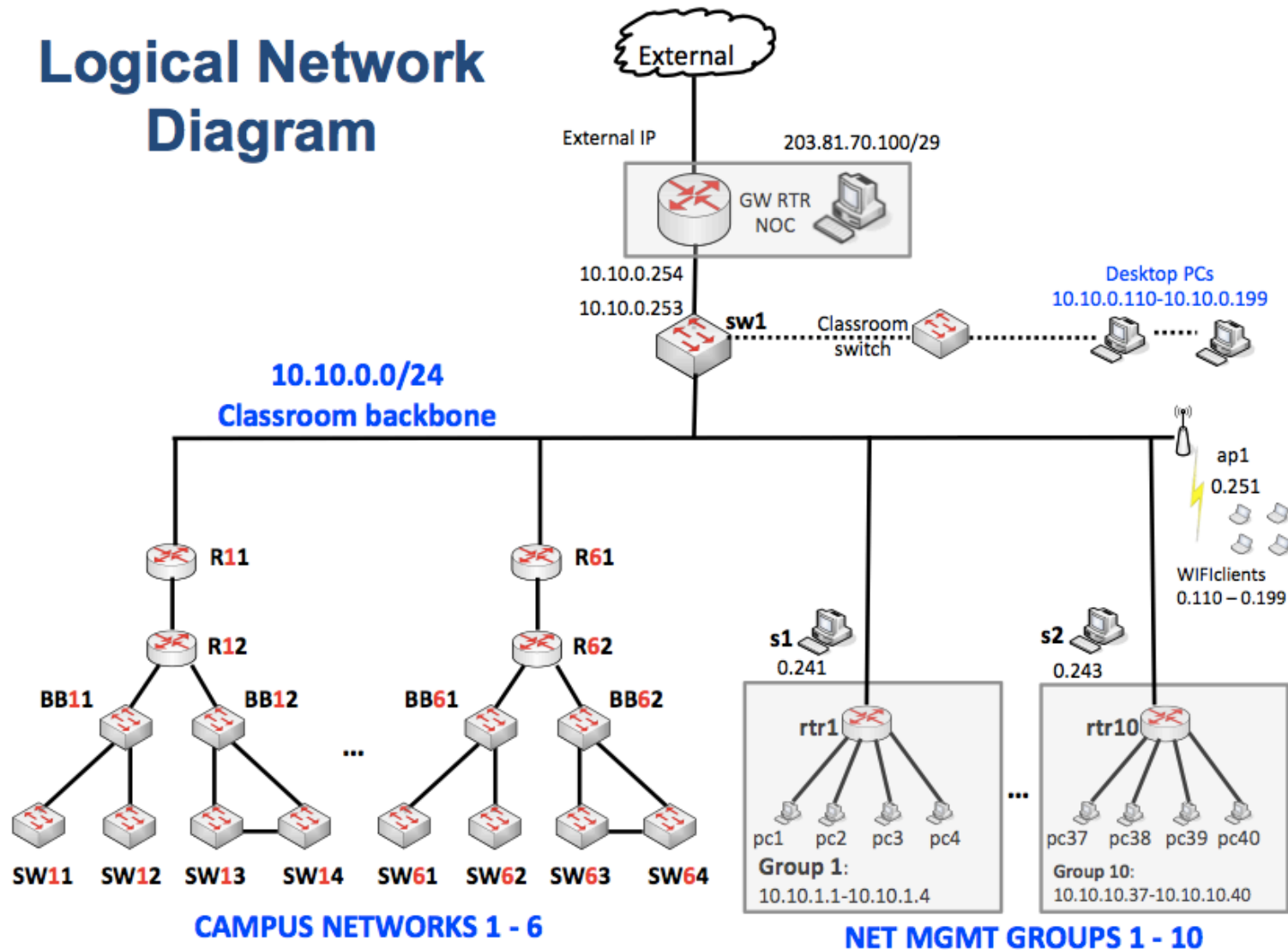
Network Management (NMM)

Logical Network Diagram



CND and NMM over 2-3 Machines

Logical Network Diagram



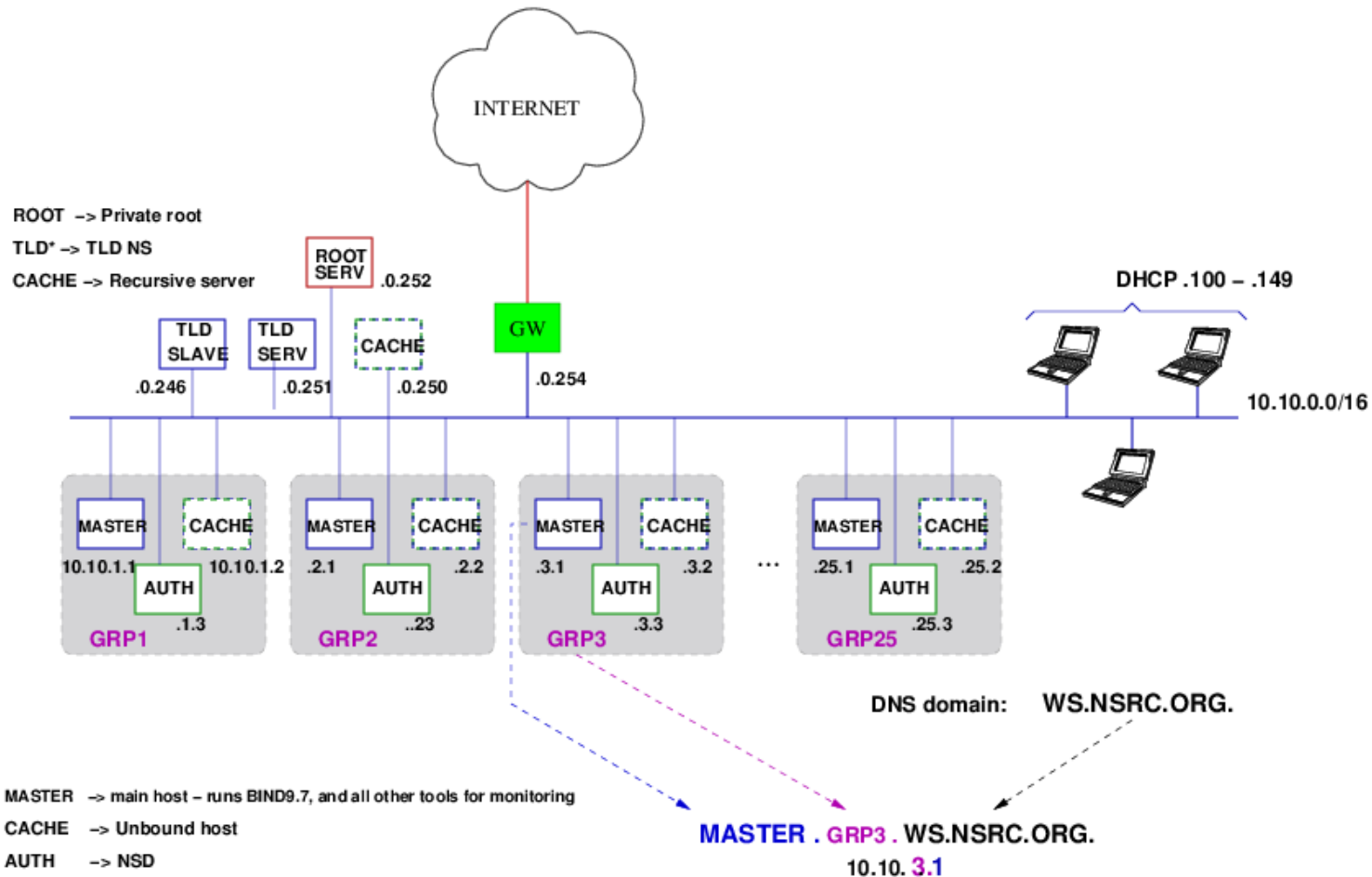
DNS/DNSSEC workshop

NETWORK LAYOUT

```
login: adm
pass: *given in class*
```

WiFi SSID: DNS or DNS2

WiFi pass: 8888888888



Benefits: Educational

- Shipping small CPUs much less expensive.
- Other benefits not tied to simple cost benefit or logistics
- Virtualization technologies part of modern IT infrastructure
 - Not just for training
 - Virtualized OS (“hypervisors”)
 - Virtualized network (VLANs, virtual switches, routers, SDN)
 - Virtualized storage (iSCSI, disk images)

Benefits: Educational (con't)

- Clear benefits for institutions offering applications and services to staff and faculty
- Professionally relevant for students and instructors
- Participants can easily re-create lab environments on laptops
- Much simpler to provide network and systems training.

Limitations...

There are, of course, some tradeoffs:

Hands-on is limited

- No manipulation of “real hardware”
 - Some people grasp concepts better
 - Cables vs VLANs
 - Reality for present-day networks and systems
- Not always possible to virtualize all hardware

What tool(s) to use?

... and new possibilities

All this simplifies capacity building...

- Lower cost, better outreach
- Increased adaptability
- More can be done
- Easy to adjust to new topics / themes

Questions?